US 20050036501A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0036501 A1**

Chung et al. (43) **Pub. Date: Feb. 17, 2005**

(54) **DOMAIN NAME SERVICE SYSTEM AND METHOD THEREOF**

(75) Inventors: **Woon-jac Chung**, Gunpo-si (KR); **Hyeong-seok Kim**, Seongnam-si (KR); **Hye-young Jung**, Seoul (KR); **Song-yean Cho**, Seoul (KR)

Correspondence Address:
SUGHRUE MION, PLLC
2100 PENNSYLVANIA AVENUE, N.W.
SUITE 800
WASHINGTON, DC 20037 (US)

(73) Assignee: **SAMSUNG ELECTRONICS CO., LTD.**

(21) Appl. No.: **10/914,202**

(22) Filed: **Aug. 10, 2004**

(30) **Foreign Application Priority Data**

Aug. 11, 2003 (KR) 10-2003-0055534

Publication Classification

(51) **Int. Cl.**[7] **H04L 12/56**

(52) **U.S. Cl.** **370/401**

(57) **ABSTRACT**

The present invention relates to a domain name service system and method thereof. According to the present invention, a domain name service can be provided through a mobile host and domain name servers having smallest hop counts, based on position information on the domain name servers included in external links. Therefore, a domain name service can be provided within a short time regardless of operating modes of the domain name servers. Furthermore, it is possible to reduce system traffic since the addresses of optimal domain name servers are provided to edge routers.

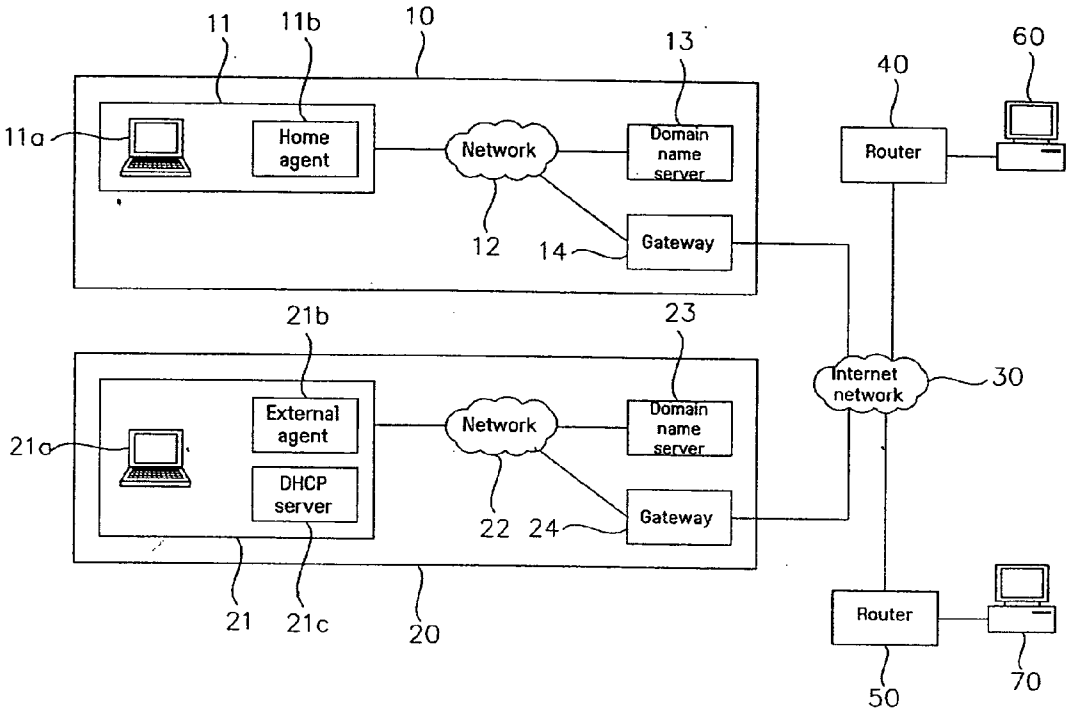


FIG. 1

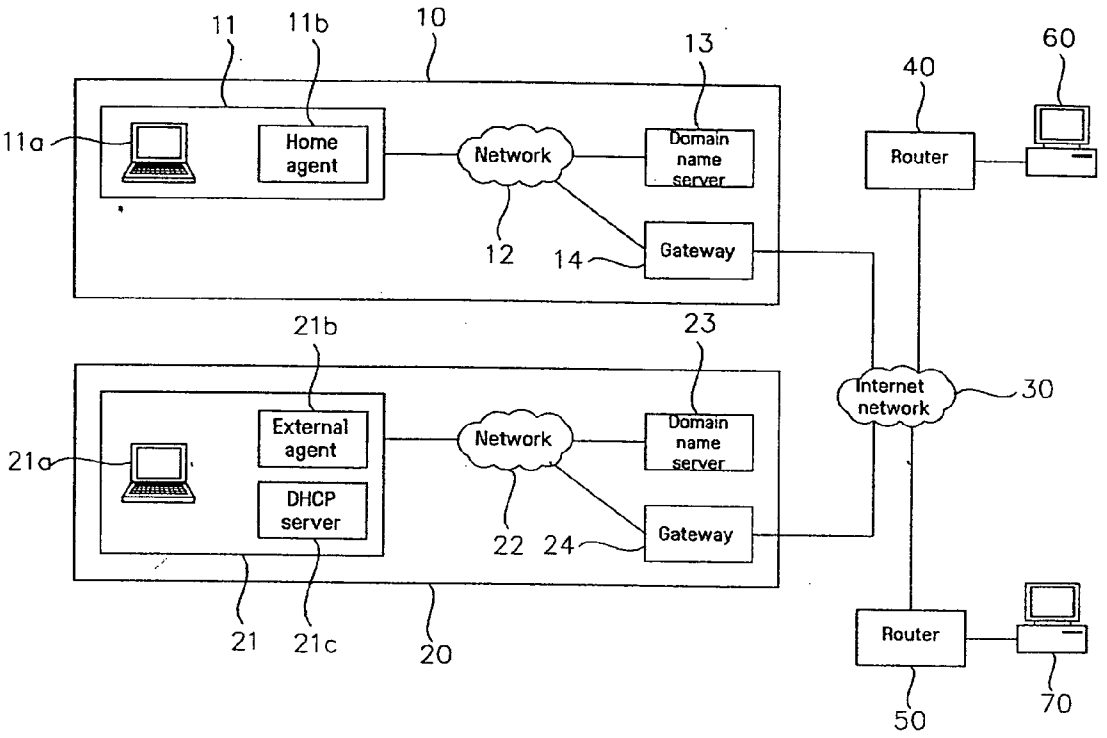

11
11b
10
13
60
40
11a
Home agent
Network
Domain name server
Router
12
14
Gateway
21b
23
Internet network
30
External agent
Network
Domain name server
21a
DHCP server
22
24
Gateway
21
21c
20
Router
50
70

FIG.2 (Prior Art)

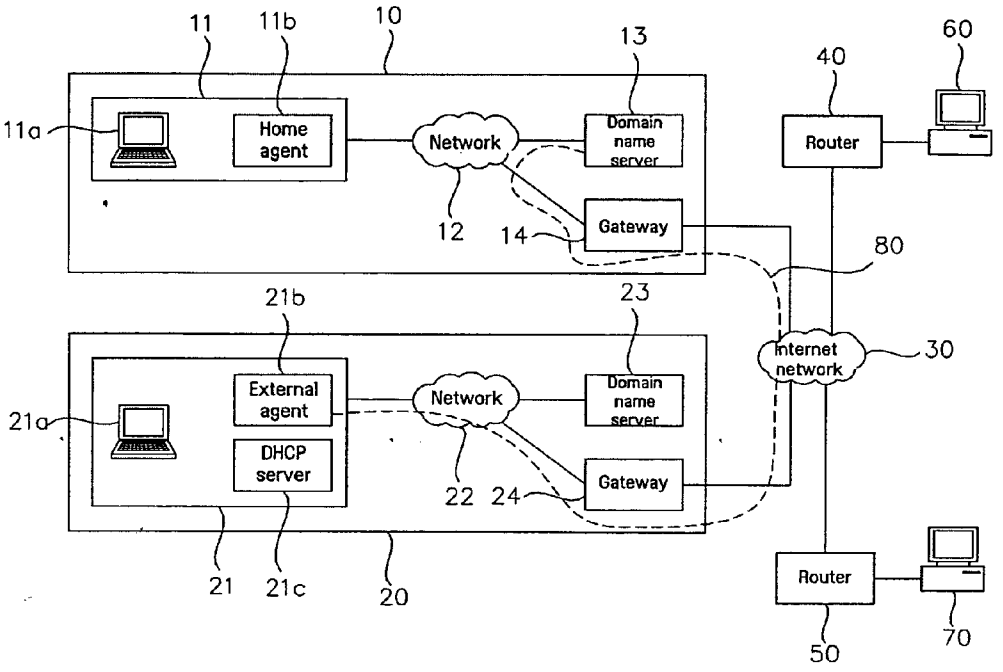


FIG. 3

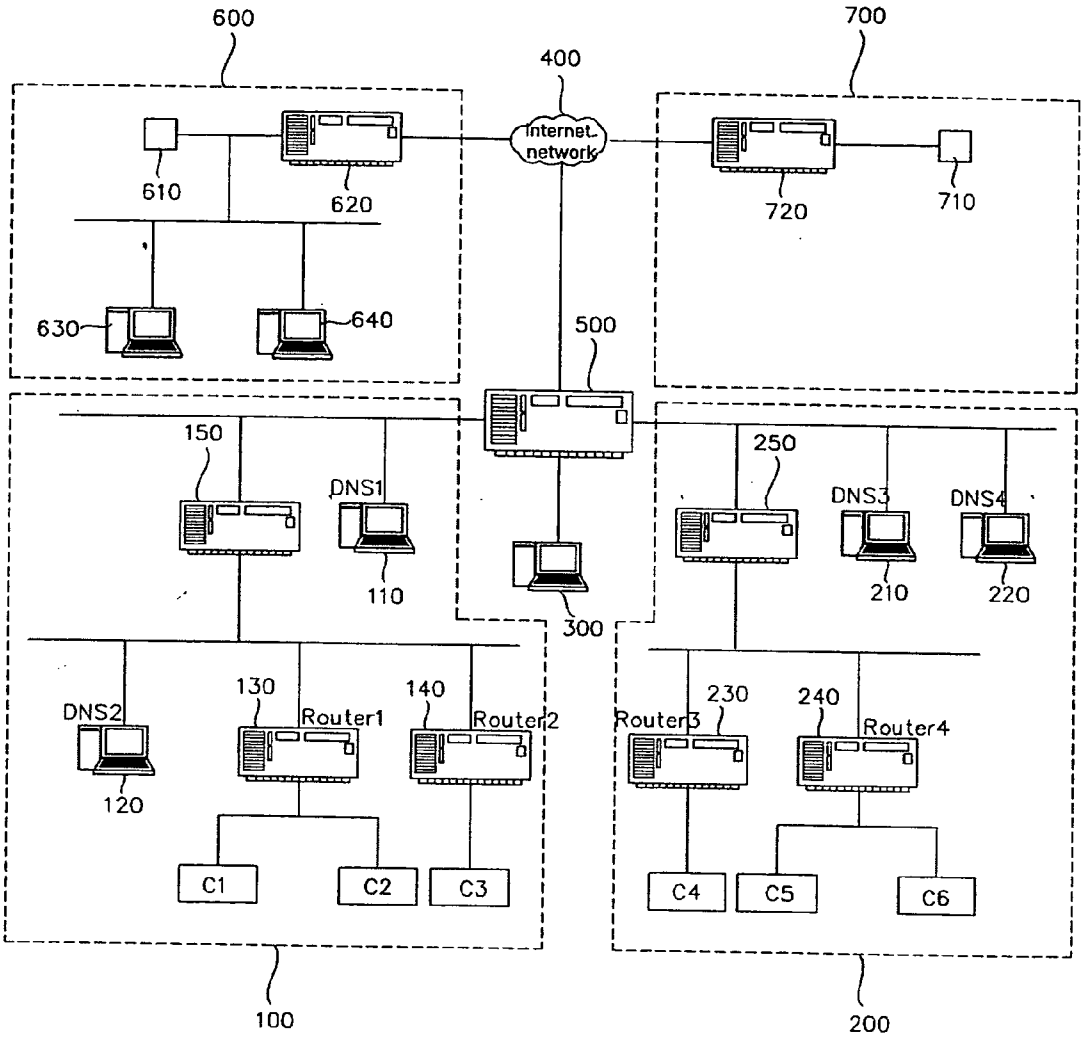

600
400
700
internet network
610
620
720
710
630
640
500
150
DNS1
250
DNS3
DNS4
110
210
220
300
DNS2
130
Router1
140
Router2
230
240
Router3
Router4
120
C1
C2
C3
C4
C5
C6
100
200

FIG.4

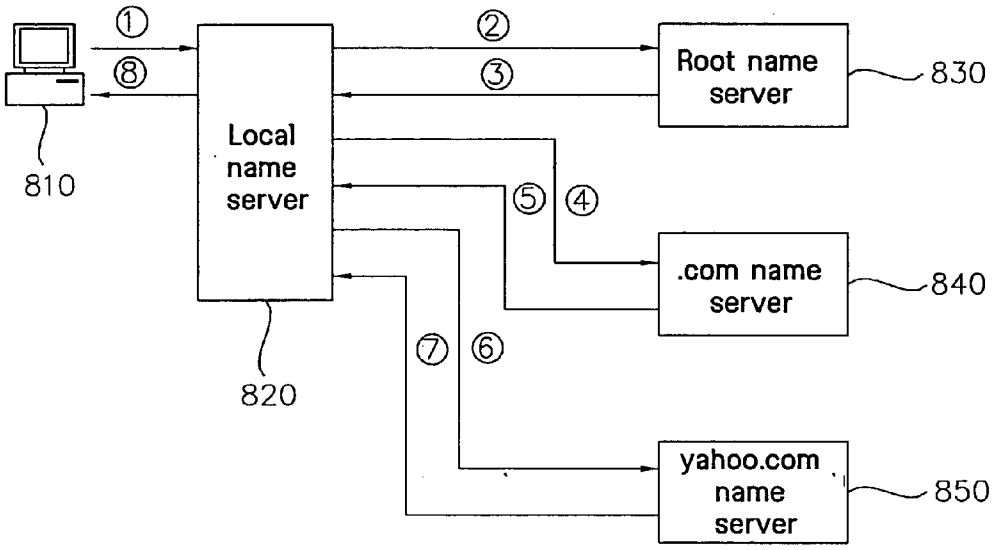

①
②
③
⑧
⑤
④
⑦
⑥
Root name server
830
Local name server
820
.com name server
840
yahoo.com name server
850
810

FIG.5

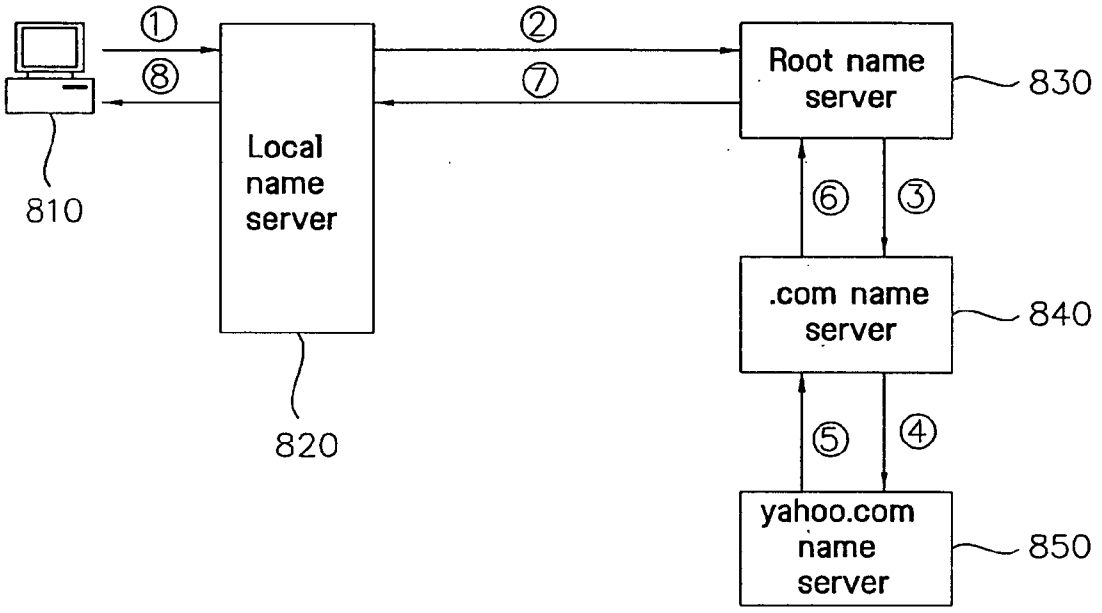

①
②
⑧
⑦
Root name server
830
Local name server
810
820
⑥
③
.com name server
840
⑤
④
yahoo.com name server
850

FIG.6

		DNS1		DNS2		DNS3		DNS4	
		HCgd	I Mode	HCgd	I Mode	HCgd	I Mode	HCgd	I Mode
		HCdr	R Mode	HCdr	R Mode	HCdr	R Mode	HCdr	R Mode
External link 1	Router1	2	?	1	?	1	?	1	?
		1	6	2	6	3	8	3	8
	Router2	2	?	1	?	1	?	1	?
		1	6	2	6	3	8	3	8
External link 2	Router3	2	?	1	?	1	?	1	?
		4	12	3	8	2	6	2	6
	Router4	2	?	1	?	1	?	1	?
		4	12	3	8	2	6	2	6

FIG. 7

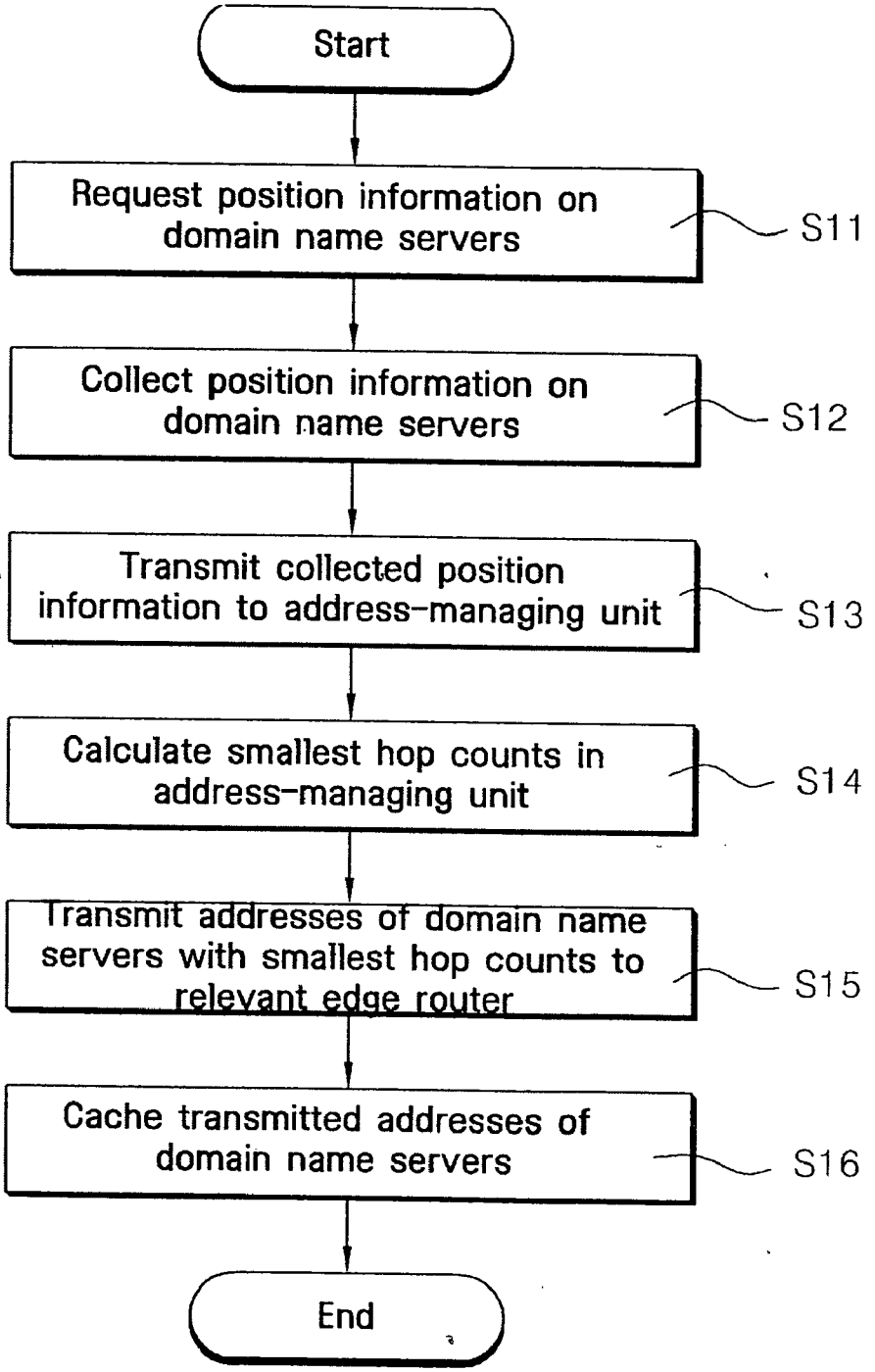

Start
Request position information on domain name servers
S11
Collect position information on domain name servers
S12
Transmit collected position information to address-managing unit
S13
Calculate smallest hop counts in address-managing unit
S14
Transmit addresses of domain name servers with smallest hop counts to relevant edge router
S15
Cache transmitted addresses of domain name servers
S16
End

FIG. 8

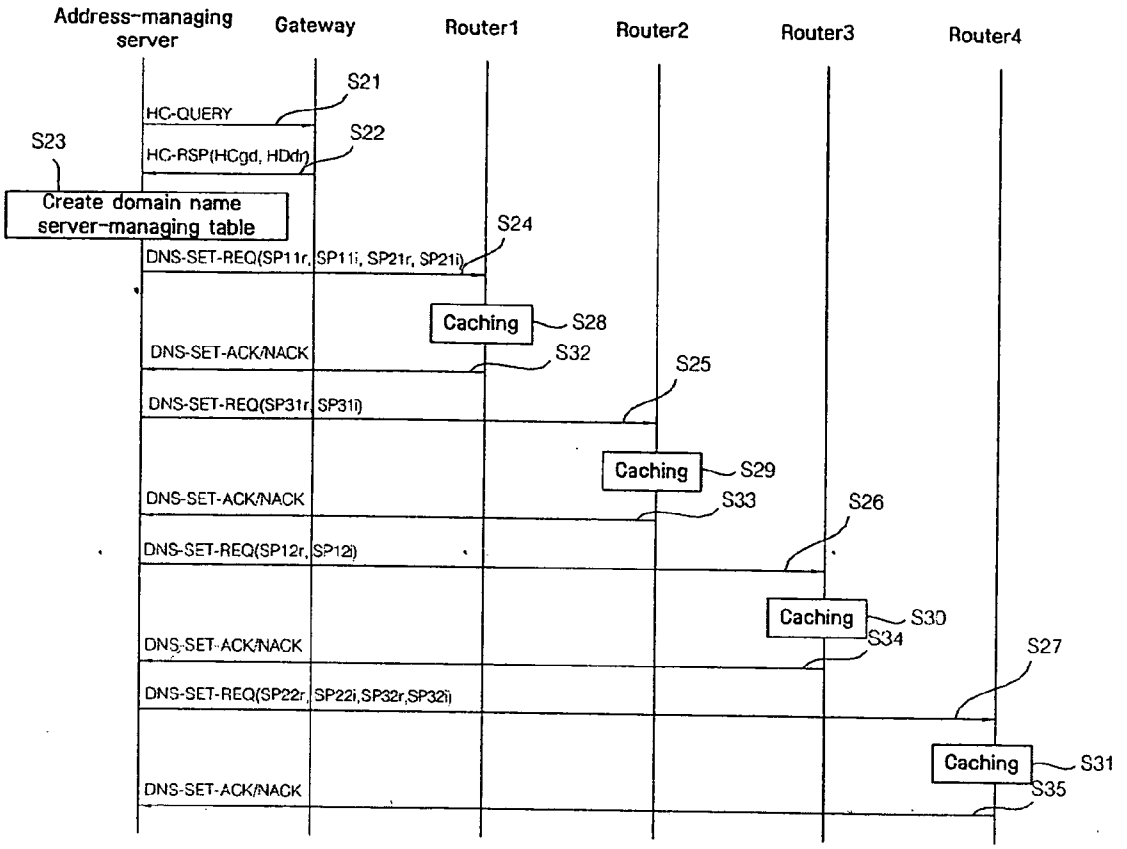

Address-managing server
Gateway
Router1
Router2
Router3
Router4
S21
HC-QUERY
S22
HC-RSP(HCgd, HDdn)
S23
Create domain name server-managing table
S24
DNS-SET-REQ(SP11r, SP11i, SP21r, SP21i)
Caching
S28
DNS-SET-ACK/NACK
S32
S25
DNS-SET-REQ(SP31r, SP31i)
Caching
S29
DNS-SET-ACK/NACK
S33
S26
DNS-SET-REQ(SP12r, SP12i)
Caching
S30
DNS-SET-ACK/NACK
S34
S27
DNS-SET-REQ(SP22r, SP22i, SP32r, SP32i)
Caching
S31
DNS-SET-ACK/NACK
S35

FIG. 9

HC Query:

Payload Proto	Header Len	MH Type=0x10	Reserved
Checksum		M (901)	T (902)

FIG. 10

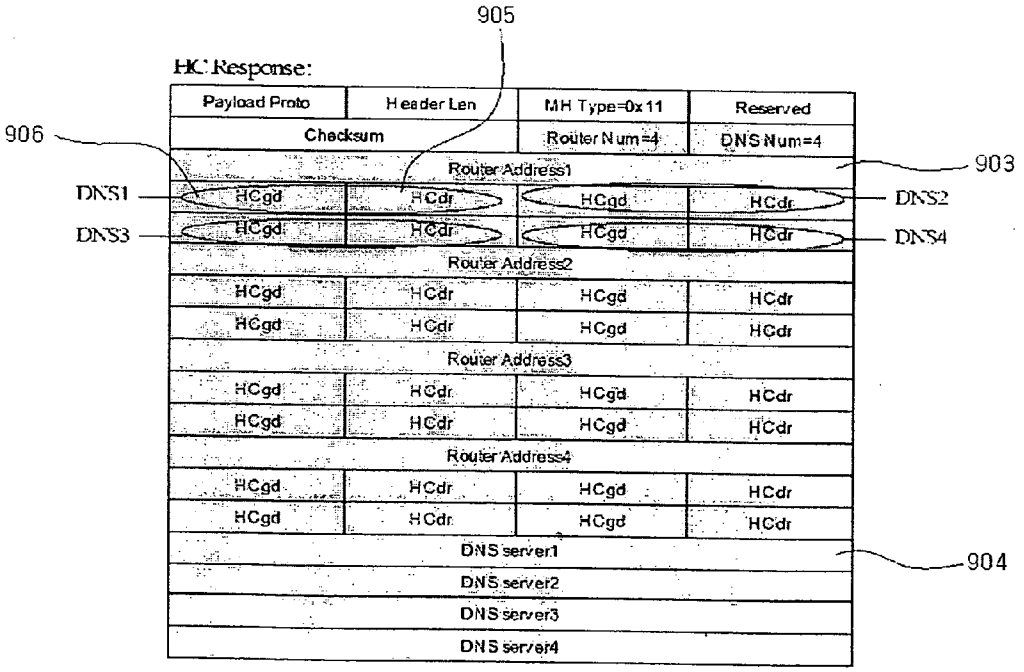


FIG. 11

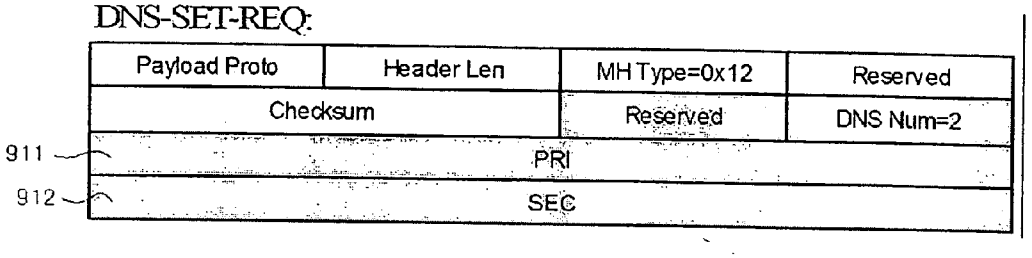

DNS-SET-REQ:
Payload Proto
Header Len
MH Type=0x12
Reserved
Checksum
Reserved
DNS Num=2
911
PRI
912
SEC

FIG. 12

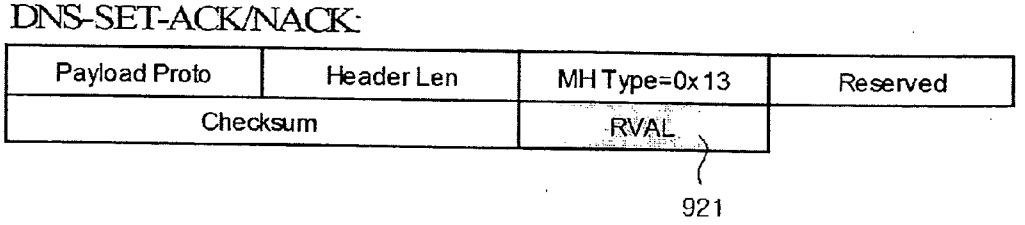

DNS-SET-ACK/NACK:
Payload Proto
Header Len
MH Type=0x13
Reserved
Checksum
RVAL
921

FIG. 13

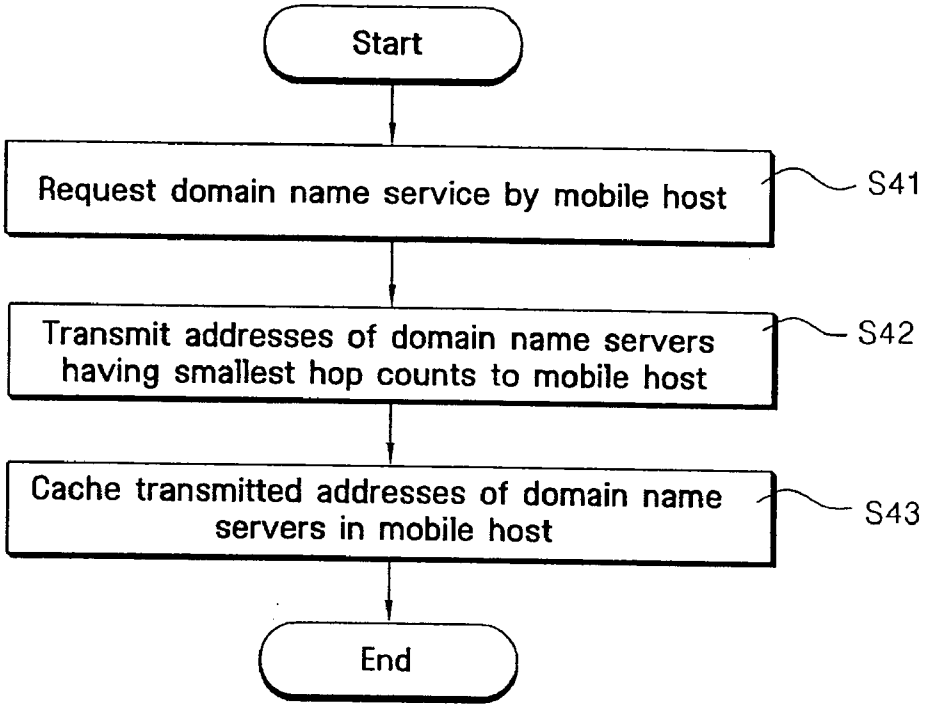

Start
Request domain name service by mobile host
S41
Transmit addresses of domain name servers having smallest hop counts to mobile host
S42
Cache transmitted addresses of domain name servers in mobile host
S43
End

FIG. 14

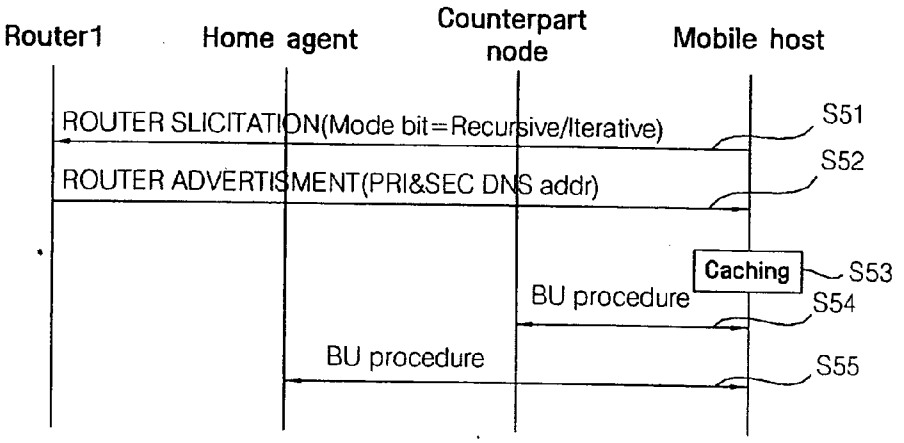

Router1
Home agent
Counterpart node
Mobile host
ROUTER SLICITATION(Mode bit=Recursive/Iterative)
S51
ROUTER ADVERTISMENT(PRI&SEC DNS addr)
S52
Caching
S53
BU procedure
S54
BU procedure
S55

FIG. 15

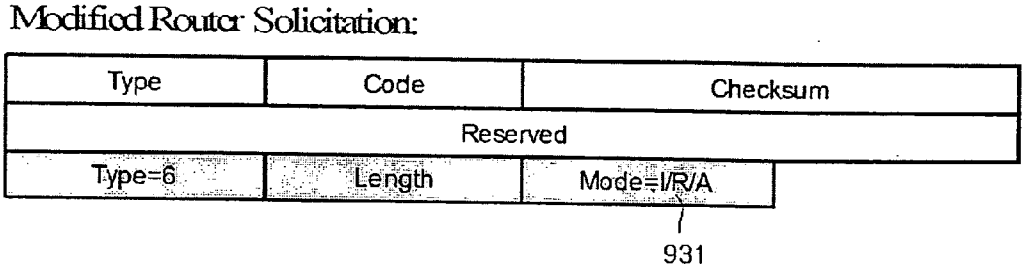

Modified Router Solicitation:
Type
Code
Checksum
Reserved
Type=6
Length
Mode=I/R/A
931

FIG. 16

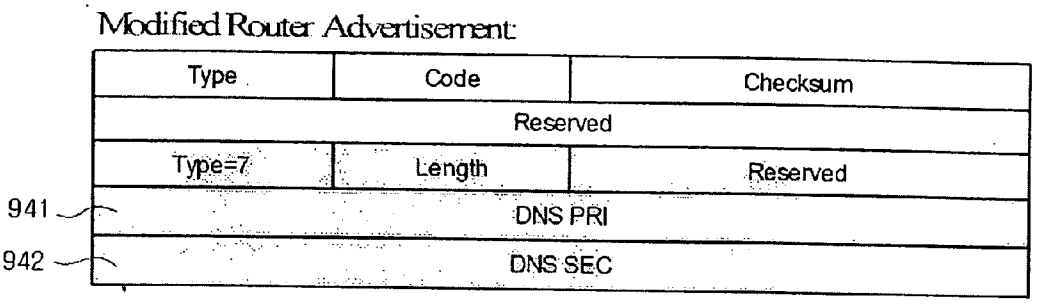

Modified Router Advertisement
Type
Code
Checksum
Reserved
Type=7
Length
Reserved
941
DNS PRI
942
DNS SEC

FIG. 17

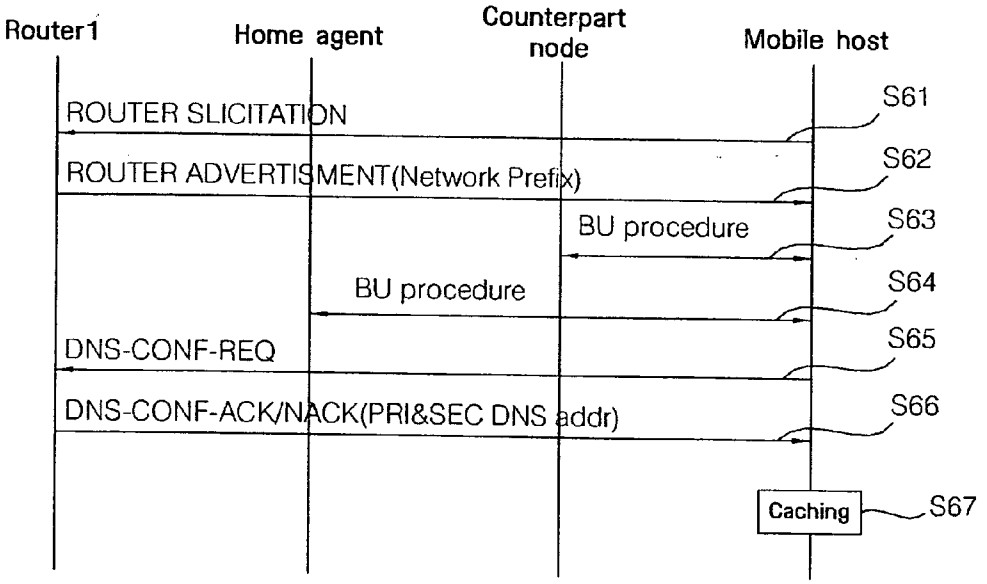

Router1
Home agent
Counterpart node
Mobile host
ROUTER SLICITATION
S61
ROUTER ADVERTISMENT(Network Prefix)
S62
BU procedure
S63
BU procedure
S64
DNS-CONF-REQ
S65
DNS-CONF-ACK/NACK(PRI&SEC DNS addr)
S66
Caching
S67

FIG. 18

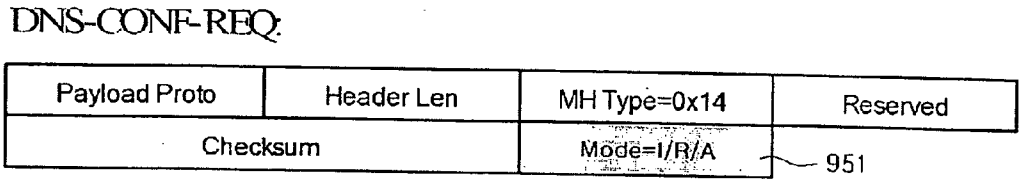
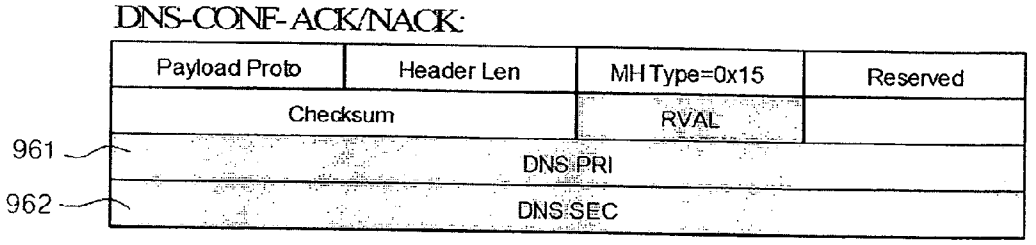

DNS-CONF-REQ:
Payload Proto
Header Len
MH Type=0x14
Reserved
Checksum
Mode=I/R/A
951

FIG. 19


DNS-CONF-ACK/NACK:
Payload Proto
Header Len
MH Type=0x15
Reserved
Checksum
RVAL
961
DNS PRI
962
DNS SEC

DOMAIN NAME SERVICE SYSTEM AND METHOD THEREOF

BACKGROUND OF THE INVENTION

[0001] This application claims the priority of Korean Patent Application No. 10-2003-0055534 filed on Aug. 11, 2003, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

[0002] 1. Field of the Invention

[0003] A system and a method consistent with the present invention relates to a domain name system, and more particularly, to a domain name service system and method thereof, wherein if a mobile host moves to an external link, a router connected to the mobile host transmits at least one address of at least one domain name server with the smallest hop count to the mobile host.

[0004] 2. Description of the Related Art

[0005] A general mobile network system is divided into a home sub domain **10** and an external sub domain **20**, depending on the locations of mobile hosts **11***a* and **21***a*. The mobile network system comprises first and second routers **40** and **50** connected to the home sub domain **10** and the external sub domain **20** via an Internet network **30**, and first and second counterpart nodes **60** and **70** that are connected to the first and second routers **40** and **50**, respectively, as shown in **FIG. 1**. Herein, it is assumed that the mobile hosts **11***a* and **21***a* are in communication with the first counterpart node **60**.

[0006] The home sub domain **10** comprises a home link **11** including the mobile host **11***a* and a home agent **11***b* for managing the mobile host **11***a*; a domain name server **13** connected to the home link **11** via a sub network **12**; and a gateway **14** connected to the sub network **12** for performing an Internet connection function.

[0007] The external sub domain **20** comprises an external link **21**, including the mobile host **21***a* resulting from the movement of the mobile host **11***a* of the home sub domain **10**, an external agent **21***b* for managing the mobile host **21***a* and a dynamic host configuration protocol (DHCP) server **21***c* for automatically configuring the address of the mobile host **21***a*; a domain name server **23** connected to the external link **21** via a sub network **22**; and a gateway **24** connected to the sub network **22** for providing an Internet connection function.

[0008] Routers are used for the home agent **11***b* and the external agent **21***b* in the same manner as the first and second routers **40** and **50** that are connected to the counterpart nodes **60** and **70**, respectively.

[0009] The operation of the mobile network system constructed as above will be described below.

[0010] In the mobile network system, if the mobile host **11***a* located at the home link **11** moves and is located at the external link **21**, the mobile host **21***a* receives a message from the external agent **21***b*, which is different from that transmitted from the home agent **11***b*. Therefore, the mobile network system recognizes that the mobile host **21***a* is located at the external link **21** rather than the home link **11**.

[0011] The mobile host **21***a* is allocated an address and network information through the DHCP server **21***c* or provided with a network prefix through the external agent **21***b* to create a care-of address by itself.

[0012] After the allocation of the address has been completed as described above, the mobile host **21***a* provides its changed address to the first counterpart node **60** and the home link **11** with which it was in communication when it was located at the home link **11**. Through the provided address, the home agent **11***b* and the first counterpart node **60** store and manage the changed address therein.

[0013] Thereafter, the mobile host **21***a* can continuously communicate with the first counterpart node **60** based on the changed address.

[0014] The second counterpart node **70** which has not yet detected that the mobile host **21***a* has moved to the external link **21** sends a packet to the home agent **11***b*. The home agent **11***b* that has received the packet resends the packet to the mobile host **21***a* located at the external link **21** based on the stored address.

[0015] Therefore, the mobile host can continuously communicate without disconnection during and after its movement.

[0016] As for a domain name service, if the mobile host **11***a* of the home link **11** has moved to the external link **21**, the mobile host **21***a* resulting from the movement uses a domain server address used in the domain name server **13** of the home sub domain **10**.

[0017] Therefore, even when the mobile host **11***a* of the home link **11** has moved to the external link **21**, the moved mobile host **21***a* still requests a domain name service through the domain name server **13** of the home link **11**, as indicated by a dotted line **80** in **FIG. 2**.

[0018] However, this causes a problem in that there is a limitation on providing an efficient domain name service due to overload on network traffic since the mobile host **21***a* receives the domain name service through the domain name server **13** of the home link **11** even though the mobile host has moved from the home link **11** to the external link **21**.

SUMMARY OF THE INVENTION

[0019] Illustrative, non-limiting embodiments of the present invention overcome the above disadvantages and other disadvantages not described above. However, the present invention is not required to overcome the disadvantages described above, and thus, an illustrative, non-limiting embodiment of the present invention may not overcome any of the problems described above.

[0020] Accordingly, it is an exemplary aspect of the present invention to provide a domain name service system and method thereof, wherein a mobile host can select a domain name server capable of providing a domain name service according to a domain where the mobile host is located, so that a domain name service can be quickly provided through the selected domain name server.

[0021] Another exemplary aspect of the present invention is to provide a domain name service system and method thereof, wherein a domain name server capable of providing

a domain name service can be selected to minimize network traffic, thereby providing an efficient domain name service.

[0022] Additional aspects and advantages of the invention will be set forth in part in the description which follows and, in part, will be understood from the description, or may be learned by practice of the invention.

[0023] The foregoing and other aspects of the present invention are achieved by providing a domain name service system that requests position information on domain name servers included in an external link of a network, and transmits the position information provided in response to the request to an edge router connected to a mobile host.

[0024] The position information may include hop counts between the edge router and the domain name servers and/or hop counts between the domain name servers and a gateway.

[0025] The smallest hop counts according to iterative and recursive modes of the domain name servers may be calculated based on the position information, and a domain name server-managing table may be created based on the position information and the calculated hop counts.

[0026] Addresses for the iterative and recursive modes of the domain name servers having smallest hop counts with respect to the edge router may be transmitted to the edge router.

[0027] In iterative mode, the smallest hop count may be calculated based on:

$$HCi=2\times HCgd\times Ldn+2\times HCdr,$$

$$DNSSPi=\{\text{Min}(HCdr)\ \}\ \text{of}\ \{\text{Min}\ (Hcgd)\ \text{lists}\},$$

[0028] where HCi is the hop count required in iterative mode, HCgd is the hop count between the gateway and each domain name server, HCdr is the hop count between each domain name server and the edge router, DNSSPi is the smallest hop count in iterative mode, and Ldn is the length of a domain name.

[0029] In recursive mode, the smallest hop count may be calculated based on:

$$HCr=2\times HCgd+2\times HCdr,$$

$$DNSSPr=\text{Min}(HCr),$$

[0030] where HCr is the hop count required in recursive mode, HCgd is the hop count between the gateway and each domain name server, HCdr is the hop count between each domain name server and the edge router, and DNSSPr is the smallest hop count in recursive mode.

[0031] Further, a domain name service system of the present invention is connected between an external link and an Internet network and adapted to collect position information on domain name servers included in the external link.

[0032] If a mobile host is located at the external link, the position information may include hop counts between an edge router connected to the mobile host and the domain name servers, and hop counts between the domain name servers and a gateway.

[0033] Moreover, in a domain name service system of the present invention, when a mobile host requests a domain name service, addresses of domain name servers having the smallest hop counts with respect to the mobile host are transmitted to the mobile host.

[0034] The addresses of the domain name servers may include the addresses of the domain name servers having the smallest hop counts for iterative and recursive modes.

[0035] When the mobile host requests the domain name service, the mobile host may make the request while selecting an operating mode of the domain name service.

[0036] A domain name service method of the present invention comprises a first step of requesting position information on domain name servers included in a network; and a second step of transmitting position information on domain name servers, which have the smallest hop counts with respect to an edge router connected to a mobile host to the edge router, in response to the request of the first step.

[0037] The position information in the first step may include hop counts between the edge router and each domain name server and hop counts between each domain name server and a gateway.

[0038] The second step may comprise a first process of transmitting addresses of the domain name servers, which have the smallest hop counts with respect to the edge router, to the edge router; and a second process of allowing the addresses of the domain name servers transmitted in the first process to be cached in the edge router.

[0039] The smallest hop counts may be calculated according to operating modes of the domain name servers.

[0040] The addresses transmitted to the edge router may include addresses for iterative and recursive modes that are operating modes of the domain name servers.

[0041] Furthermore, a domain name service method of the present invention comprises a first step of transferring a request for position information on domain name servers included in an external link; and a second step of collecting and storing the position information on the domain name servers in response to the request of the first step.

[0042] The second step may include allowing a gateway connected between the external link and an Internet network to collect and store the position information.

[0043] The second step may comprise a first process of, by a sub router for connecting the external link to the gateway, collecting the position information; and a second process of causing the position information collected in the first process to be stored in the gateway.

[0044] Moreover, a domain name service method of the present invention comprises a first step of, by a mobile host, requesting a domain name service due to changes in a link to which the mobile host is connected; and a second step of transmitting addresses of domain name servers, which have the smallest hop counts with respect to an edge router connected to the mobile host, to the mobile host, in response to the request of the first step.

[0045] The first step may include requesting the edge router connected to the mobile host in the changed link to provide the domain name service.

[0046] The second step may comprise a first process of transmitting the addresses of the domain name servers, which have the smallest hop counts with respect to the edge

router, to the mobile host in response to the request of the first step; and a second process of causing the addresses transmitted in the first process to be cached in the mobile host.

[0047] The first step may comprise a first process of requesting a domain name server, which is included in a first link to which the mobile host was connected before connecting to a second link, to provide the domain name service; and a second process of providing the domain name service through the domain name server in the first process.

[0048] The second step may comprise a first process of requesting the edge router, which is included in the second link, to provide the domain name service; a second process of transmitting addresses of domain name servers, which have the smallest hop counts with respect to the edge router of the first process, to the mobile host; and a third process of causing the addresses in the second process to be cached in the mobile host.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049] The above and other objects, features and advantages of the present invention will become apparent from the following description of illustrative, non-limiting embodiments given in conjunction with the accompanying drawings, in which:

[0050] **FIG. 1** is a view showing the configuration of a general mobile network;

[0051] **FIG. 2** is a view showing the flow of a conventional domain name service;

[0052] **FIG. 3** is a view showing the configuration of a domain name service system according to present invention;

[0053] **FIG. 4** is a block diagram showing an iterative mode of a domain name service according to present invention;

[0054] **FIG. 5** is a block diagram showing a recursive mode of the domain name service according to present invention;

[0055] **FIG. 6** shows a domain name server-managing table generated by an address-managing server according to present invention;

[0056] **FIG. 7** is a flowchart illustrating a first embodiment of a domain name service method according to the present invention;

[0057] **FIG. 8** is a view showing the flow of the domain name service according to present invention;

[0058] **FIG. 9** is a view showing the structure of a request message of an address-managing unit according to present invention;

[0059] **FIG. 10** is a view showing the structure of a domain name server position information message that is transmitted to the address-managing unit according to present invention;

[0060] **FIG. 11** is a view showing the structure of a domain name server address message that is transmitted to an edge router according to present invention;

[0061] **FIG. 12** is a view showing the structure of a response message of the edge router according to present invention;

[0062] **FIG. 13** is a flowchart illustrating a second embodiment of a domain name service method according to the present invention;

[0063] **FIG. 14** is a view showing a first embodiment of the flow of a domain name service in a mobile host according to the present invention;

[0064] **FIG. 15** is a view showing the structure of a domain name service request message of the mobile host according to present invention;

[0065] **FIG. 16** is a view showing the structure of a domain name server address message that is transmitted from the edge router in response to a request of the mobile host according to present invention;

[0066] **FIG. 17** is a view showing a second embodiment of the flow of the domain name service in the mobile host according to the present invention;

[0067] **FIG. 18** is a view showing the structure of a domain name service request message of the mobile host according to present invention; and

[0068] **FIG. 19** is a view showing the structure of a domain name server address message that is transmitted from the edge router in response to a request of the mobile host according to present invention.

DETAILED DESCRIPTION OF ILLUSTRATIVE, NON-LIMITING EMBODIMENTS OF THE INVENTION

[0069] Hereinafter, illustrative, non-limiting embodiments of the present invention will be described in detail with reference to accompanying drawings.

[0070] As shown in **FIG. 3**, a domain name service system according to the present invention comprises an address-managing unit **300** and an address-collecting unit **500**. The address-managing unit **300** requests position information on first to fourth domain name servers **110**, **120**, **210** and **220** that are installed in first and second external links **100** and **200** included in a network, and transmits the requested position information to first to fourth edge routers **130**, **140**, **230** and **240** connected to mobile hosts. Further, the address-collecting unit **500** collects position information on the domain name servers **110**, **120**, **210** and **220** included in the first and second external links **100** and **200** in response to the request of the address-managing unit **300** and sends the collected position information to the address-managing unit **300**.

[0071] A gateway that is connected between the first and second external links **100** and **200** and an Internet network **400**, which performs an Internet connection function of the first and second external links **100** and **200**, is used for the address-collecting unit **500**.

[0072] Furthermore, a home link **600** at which a mobile host was initially located and which was connected to the Internet network **400** is still connected to the Internet network **400**, and a counterpart link **700** that performed

communications through the home link **600** and the Internet network **400** is also still connected to the Internet network **400**.

[**0073**] The home link **600** comprises a home agent **610** for managing a mobile host, a home gateway **620** connected to the home agent **610** to perform an Internet connection function of the mobile host, and home domain name servers **630** and **640** for providing the mobile host with a domain name service.

[**0074**] Further, the counterpart link **700** comprises a counterpart node **710** that performs communications with the mobile host, and a counterpart gateway **720** connected between the counterpart node **710** and the Internet network **400** to perform an Internet connection function of the counterpart node **710**.

[**0075**] The counterpart node **710** may be an arbitrary mobile host, a server or the like which performs communications with the mobile host.

[**0076**] The first and second external links **100** and **200** comprise first and second sub routers **150** and **250** connected to the address-collecting unit **500**, the first to fourth domain name servers **110**, **120** and **210**, **220** connected to the first and second sub routers **150** and **250**, respectively, and the first to fourth edge routers **130**, **140** and **230**, **240** which are connected to the sub routers **150** and **250** and, if the mobile host of the home link **600** has moved, are to be connected to the moved mobile host of the home link **600**, respectively.

[**0077**] Furthermore, one or more cells C**1**, C**2**, C**3**, C**4**, C**5** and C**6** are connected to the first to fourth edge routers **130**, **140**, **230** and **240**. The cells C**1**, C**2**, C**3**, C**4**, C**5** and C**6** are regions to which communications are relayed by arbitrary stations connected to the first to fourth edge routers **130**, **140**, **230** and **240**.

[**0078**] Further, when the address-managing unit **300** requests position information, the address-collecting unit **500** collects position information containing hop counts between the first to fourth edge routers **130**, **140**, **230** and **240** and the first to fourth domain name servers **110**, **120**, **210** and **220** included in the first and second external links **100** and **200**, and hop counts between the first to fourth domain name servers **110**, **120**, **210** and **220** and the address-collecting unit **500**. The address-collecting unit **500** transmits the collected position information to the address-managing unit **300**.

[**0079**] The address-managing unit **300** creates a domain name server-managing table according to iterative and recursive modes in the first to fourth domain name servers **110**, **120**, **210** and **220** based on the received position information.

[**0080**] The iterative and recursive modes will be described hereinafter through a domain name service for "www.yahoo.com."

[**0081**] First, in case of the iterative mode shown in **FIG. 4**, when a client **810** requests a local name server **820** to provide a domain name service through an IP address or a domain name (①), the local name server **820** requests a root name server **830** to provide a domain name service in reverse order of the domain name (②).

[**0082**] Thereafter, the root name server **830** make a response by informing the local name server **820** of addresses having a requested sub-domain ".com" entry (③). The local name server **820** iteratively requests sub servers **840** and **850** to inform the local name server **820** of an address for the domain name based on the previous sub-domain ".com" domain until an address is acquired (④,⑤,⑥, and ⑦). When the local name server **820** that finally acquires the address, it sends the IP address of the domain name to the client **810** (⑧).

[**0083**] Next, in case of the recursive mode shown in **FIG. 5**, when the client **810** requests the local name server **820** to provide a domain name service using an IP address or a domain name as an input parameter (①), the local name server **820** first requests the root name server **830** to provide a domain name service in reverse order of the domain name ②).

[**0084**] The root name server **830** that has received the request sends a query message to name servers **840** and **850** having the sub-domain ".com" of the root name server **830** (③,④).

[**0085**] This process is repeatedly performed until an address for the domain name is acquired. When an address is finally acquired, the final name server **850** sends the address to its higher-level domain server **840** (⑤). This process is repeated until the address is transmitted to the local name server **820** (⑥,⑦).

[**0086**] Thereafter, the local name server **820** that has received the address sends the address for the requested domain name to the client **810** (⑧).

[**0087**] The domain name server-managing table according to the iterative and recursive modes, as shown in **FIG. 6**, contains hop counts (HCdr) between the first to fourth edge routers **130**, **140**, **230** and **240** and the first to fourth domain name servers **110**, **120**, **210** and **220** included in the first and second external links **100** and **200**; and hop counts (HCgd) between the first to fourth domain name servers **110**, **120**, **210** and **220** and an external gateway. According to an operating mode of the first to fourth domain name servers **110**, **120**, **210** and **220**, i.e. iterative or recursive mode, the smallest hop counts between the first to fourth domain name servers **110**, **120**, **210** and **220** and the first to fourth edge routers **130**, **140**, **230** and **240** are calculated.

[**0088**] In **FIG. 6**, "I Mode" means iterative mode and "R Mode" means recursive mode.

[**0089**] The reason that the smallest hop counts for the iterative mode in **FIG. 6** have not been determined is that the hop count varies depending on the length of a domain name in iterative mode and hop counts prior to the root name server **820** can be determined in recursive mode.

[**0090**] The address-managing unit **300** transmits addresses for domain name servers having the smallest hop counts with respect to each of the first to fourth edge routers **130**, **140**, **230** and **240** included in the first and second external links **100** and **200** for both iterative and recursive modes thereof. The addresses are cached in the first to fourth edge routers **130**, **140**, **230** and **240**.

[**0091**] If a mobile host located at the home link **600** has moved to and has been located at the first or second external link **100** or **200**, the moved mobile host requests one of the first to fourth edge routers **130**, **140**, **230** and **240** to which the mobile host has been connected to provide a domain name service.

[0092] The mobile host requests the domain name service while selecting the operating mode of the domain name server, i.e. iterative or recursive mode.

[0093] The edge router connected to the mobile host sets an address for the mode selected by the mobile host as a primary address and an address for the remaining mode as a secondary address, and then sends the addresses to the mobile host.

[0094] A domain name service method performed by the domain name service system constructed as above according to present invention will be described below.

[0095] In the domain name service method illustrated in **FIG. 7**, the address-managing unit **300** first requests position information on the first to fourth domain name servers **110**, **120**, **210** and **220** included in the first and second external links **100** and **200** (S11).

[0096] In response to the request of the address-managing unit **300**, the address-collecting unit **500** collects position information on the first to fourth domain name servers **110**, **120**, **210** and **220** included in the first and second external links **100** and **200** (S12).

[0097] The address-collecting unit **500** then transmits the collected position information to the address-managing unit **300** (S13).

[0098] The address-managing unit **300** acquires domain name servers having the smallest hop counts for the operating modes of the domain name servers, ie. iterative and recursive modes, from the first to fourth edge routers **130**, **140**, **230** and **240** based on the received position information. (S14).

[0099] At this time, the address-managing unit **300** calculates the smallest hop counts for the iterative and recursive modes based on the following formulas 1 and 2:

$$HCi=2\times HCgd\times Ldn+2\times HCdr,$$

$$DNSSPi=\{\text{Min}(HCdr)\} \text{ of } \{\text{Min}(HCgd) \text{ lists}\}, \quad (1)$$

[0100] where HCi is the hop count required in iterative mode, HCgd is the hop count between a gateway and a domain name server, HCdr is the hop count between a domain server and an edge router, DNSSPi is the smallest hop count in iterative mode, and Ldn is the length of a domain name.

[0101] A domain name service query message is transmitted from the first edge router **130** to the second domain name server **120** and a domain name service response message is transmitted from the second domain name server **120** to the first edge router **130**. Therefore, the estimated hop count becomes 2×HCdr.

[0102] Further, since messages should be iteratively resent to the address-collecting unit **500** according to domain name, the estimated hop count becomes 2×HCdg×Ldn. As a result, formula 1 has been obtained.

[0103] In formula 2:

$$HCr=2\times HCgd+2\times HCdr$$

$$DNSSPr=\text{Min}(HCr) \quad (2)$$

[0104] where HCr is the hop count required in recursive mode, HCgd is the hop count between a gateway and a domain name server, HCdr is the hop count between a domain server and an edge router, and DNSSPr is the smallest hop count in recursive mode.

[0105] In formula 2, a domain name service query message is transmitted from the first edge router **130** to the second domain name server **120** and the first edge router **130** receives a response message from the second domain name server **120**. Therefore, the estimated hop count becomes 2×HCdr.

[0106] Furthermore, since information is acquired through the Internet network **400**, messages are exchanged between the second domain name server **120** and the address-collecting unit **500**. Thus, the estimated hop count becomes 2×HCgd. Accordingly, formula 2 has been obtained.

[0107] Addresses of domain name servers having the smallest hop counts with respect to the first to fourth edge routers **130**, **140**, **230** and **240** are transmitted to the first to fourth edge routers **130**, **140**, **230** and **240** according to the smallest hop counts calculated in the address-managing unit **300** (S15).

[0108] The addresses of the domain name servers transmitted to the first to fourth edge routers **130**, **140**, **230** and **240** are cached therein, respectively (S16).

[0109] The domain name service method described above will be discussed in greater detail with reference to **FIG. 8**. The address-managing unit **300** requests the address-collecting unit **500** to transmit position information on the first to fourth domain name servers **110**, **120**, **210** and **220** (S21).

[0110] As shown in **FIG. 9**, the request message transmitted to the address-collecting unit **500** may be a message that causes the address-collecting unit **500** to directly collect position information on the first to fourth domain name servers **110**, **120**, **210** and **220**, or causes the first and second sub routers **150** and **250** of the first and second external links **100** and **200** to collect the position information and then send the collected position information to the address-collecting unit **500**.

[0111] Therefore, M **901** in **FIG. 9** indicates that the address-collecting unit **500** collects the position information by itself, and T **902** indicates that the first and second sub routers **150** and **250** collect the position information and then transmit it to the address-collecting unit **500**.

[0112] The address-collecting unit **500** collects position information on the first to fourth domain name servers **110**, **120**, **210** and **220** in response to the request of the address-managing unit **300** and then transmits the collected position information to the address-managing unit **300** (S22).

[0113] A position information message transmitted to the address-managing unit **300** will be described. As shown in **FIG. 10**, the position information message contains an address **903** of each of the edge routers **130**, **140**, **230** and **240**, a hop count **905** between each of the edge routers **130**, **140**, **230** and **240** and each of the domain name servers **110**, **120**, **210** and **220**, and a hop count **906** between each of the domain name servers **110**, **120**, **210** and **220** and the address-collecting unit **500**.

[0114] The position information message further contains an address **904** of each of the domain name servers **110**, **120**, **210** and **220**.

[0115] The address-managing unit **300** creates a domain name server-managing table based on the position information received from the address-collecting unit **500** and calculates the smallest hop count between each of the edge routers **130**, **140**, **230** and **240** and each of the domain name servers **110**, **120**, **130** and **140** (S**23**).

[0116] After calculating the smallest hop counts, the address-managing unit **300** sends the edge routers **130**, **140**, **230** and **240** addresses of domain name servers having the smallest hop counts with respect to the respective edge routers (S**24**, S**25**, S**26**, S**27**).

[0117] The addresses of the domain name servers transmitted to the edge routers **130**, **140**, **230** and **240** are generally in a format of SP**11***i* or SP**11***r*. The first "1" of "11" indicates a cell number of one of the cells C**1**, C**2**, C**3**, C**4**, C**5** and C**6** connected to the edge routers **130**, **140**, **230** and **240**, and the second "1" of "11" indicates the number of one of the external links. Furthermore, the final "i" and "r" indicate the iterative and recursive modes, respectively.

[0118] An address message of each of the domain name servers **110**, **120**, **210** and **220** contains a primary address **911** of the domain name server and a secondary address **912** thereof, as shown in **FIG. 11**.

[0119] When the addresses of the domain name servers **110**, **120**, **210** and **220** are transmitted to the edge routers **130**, **140**, **230** and **240**, they are cached in the edge routers (S**28**, S**29**, S**30** and S**31**).

[0120] The edge routers send relevant response messages to the address-managing server **300** (S**32**, S**33**, S**34**, S**35**).

[0121] Each response message contains a return value (RVAL) **921** according to the transmission of the addresses of the domain name servers, as shown in **FIG. 12**.

[0122] A domain name server service method wherein addresses of domain name servers having the smallest hop counts are cached in the edge routers **130**, **140**, **230** and **240** and a mobile host is connected to any one of the edge routers **130**, **140**, **230** and **240** will be described with reference to **FIG. 13**.

[0123] First, a mobile host that has moved from the home link **600** requests a domain name service through a given edge router connected thereto in the first external link **100** or the second external link **200** (S**41**).

[0124] In response to the request of the mobile host, the edge router connected to the mobile host transmits the address of a domain name server having the smallest hop count to the mobile host (S**42**).

[0125] The transmitted address of the domain name server is cached in the mobile host (S**43**).

[0126] Accordingly, the mobile host receives the domain name service through the cached address.

[0127] The domain name service method for the mobile host described above will be discussed in greater detail with reference to **FIG. 14**.

[0128] The mobile host first requests an edge router to provide a domain name service in an external link to which the mobile host has moved (S**51**). The mobile host makes the request while selecting an operating mode of a domain name server, i.e. iterative or recursive mode, when requesting the domain name service.

[0129] A mode request message of the mobile host is requested by selecting an operating mode **931** of the domain name server, as shown in **FIG. 15**. In **FIG. 15**, I/R/A means Iterative/Recursive/All.

[0130] In response to the request of the mobile host, the edge router sets an address of the mode requested by the mobile host as a primary address and then transmits it to the mobile host (S**52**).

[0131] The message to be transmitted by the edge router is sent in a state where the address of the mode selected by the mobile host is set as the primary address **941** and an address of the remaining mode is set as a secondary address **942**, as shown in **FIG. 16**.

[0132] The mobile host that has received the address of the domain name server from the edge router caches the address therein (S**53**).

[0133] Thereafter, the mobile host performs a binding update process together with the home agent **610** and the counterpart node **710** (S**54**, S**55**).

[0134] When the mobile host moves to the first or second external link **100** or **200**, the mobile host makes connection through an existing domain name service and then receives an address of a domain name server having the smallest hop count with respect to a relevant edge router.

[0135] In such a process, as shown in **FIG. 17**, the mobile host first requests the domain name servers **630** and **640** in the home link **600** to provide a domain name service (S**61**).

[0136] In response to this request, the mobile host receives the addresses of the domain name servers **630** and **640** in the home link **600** (S**62**).

[0137] Then, the mobile host performs the binding update process together with the home agent **610** and the counterpart node **710** based on the received addresses of the domain name servers **630** and **640** (S**63**, S**64**).

[0138] Then, after the mobile host has moved to the first external link **100** or the second external link **200**, it requests an edge router connected thereto to transmit a domain name service operating mode (S**65**).

[0139] The request message is transmitted in a state where an operating mode **951** of a domain name service is selected, as shown in **FIG. 18** (S**65**). In **FIG. 18**, I/R/A means Iterative/Recursive/All.

[0140] The edge router connected to the moved mobile host transmits addresses of domain name servers having the smallest hop counts to the mobile host (S**66**).

[0141] The message transmitted from the edge router to the mobile host is transmitted in a state where an address for a mode selected by the mobile host is set as a primary address **961** and an address for the remaining mode is set as a secondary address **962**, as shown in **FIG. 19**.

[0142] The addresses of the domain name servers transmitted to the mobile host are cached therein so that the mobile host can receive the domain name service (S**67**).

[0143] According to present invention described above, a domain name service can be provided through a mobile host and domain name servers having the smallest hop counts, based on position information on the domain name servers included in external links. Therefore, it is possible to provide a domain name service within a short time regardless of operating modes of the domain name servers. Furthermore, it is possible to reduce system traffic since the addresses of optimal domain name servers are provided to the edge routers.

[0144] The present invention has been described in connection with various illustrative embodiments as illustrated in the accompanying drawings, and it will be apparent to those skilled in the art that various modifications and changes can be made thereto without departing from the scope and spirit of the invention, as defined in the appended claims. Therefore, simple changes to the embodiments of the present invention will fall within the scope of the present invention.

What is claimed is:

1. A domain name service system, comprising:

an address-managing unit that requests position information on one or more domain name servers included in an external link of a network, and transmits the position information to an edge router connected to a mobile host.

2. The system as claimed in claim 1, wherein the position information includes one or more hop counts between the edge router and each of the domain name servers and one or more hop counts between each of the domain name servers and a gateway.

3. The system as claimed in claim 2, wherein a smallest hop count according to an iterative mode of each of the domain name servers and a smallest hop count according to a recursive mode of each of the domain name servers are calculated based on the position information, and

a domain name server-managing table is created based on the position information and the calculated smallest hop counts.

4. The system as claimed in claim 3, wherein one or more addresses for the iterative mode and the recursive mode of the one or more domain name servers having the smallest hop counts with respect to the edge router are transmitted to the edge router.

5. The system as claimed in claim 4, wherein in the iterative mode, the smallest hop count is calculated based on:

$$HCi=2\times HCgd\times Ldn+2\times HCdr,$$

$$DNSSPi=\{\text{Min}(HDdr)\} \text{ of } \{\text{Min}(HCgd) \text{ lists}\},$$

where HCi is the hop count required in the iterative mode, HCgd is the hop count between the gateway and each of the domain name servers, HCdr is the hop count between each of the domain name servers and the edge router, DNSSPi is the smallest hop count in the iterative mode, and Ldn is the length of a domain name.

6. The system as claimed in claim 4, wherein in the recursive mode, the smallest hop count is calculated based on:

$$HCr=2\times HCgd+2\times HCdr,$$

$$DNSSPr=\text{Min}(HCr),$$

where HCr is the hop count required in the recursive mode, HCgd is the hop count between the gateway and each of the domain name servers, HCdr is the hop count between each of the domain name servers and the edge router, and DNSSPr is the smallest hop count in the recursive mode.

7. A domain name service system, comprising:

an address-collecting unit, connected between an external link of a network and an Internet network, that collects position information on one or more domain name servers included in the external link.

8. The system as claimed in claim 7, wherein if the mobile host is located at the external link, the position information includes one or more hop counts between an edge router and each of the domain name servers and one or more hop counts between each of the domain name servers and a gateway.

9. A domain name service system, comprising:

an address-providing unit that transmits one or more addresses of one or more domain name servers to a mobile host requesting a domain name service,

wherein the one or more addresses respectively correspond to one or more domain name servers having the smallest hop counts with respect to the mobile host.

10. The system as claimed in claim 9, wherein one or more of the addresses of one or more of the domain name servers include an address of at least one domain name server having the smallest hop count for an iterative mode and an address of at least one domain name server having the smallest hop count for a recursive mode.

11. The system as claimed in claim 10, wherein

when the mobile host requests the domain name service, the mobile host selects an operating mode of the domain name service.

12. A domain name service method, comprising:

requesting position information on one or more domain name servers included in a network; and

transmitting the position information on one or more domain name servers having the smallest hop counts with respect to an edge router connected to a mobile host, to the edge router.

13. The method as claimed in claim 12, wherein the position information includes hop counts between the edge router and each domain name server and hop counts between each domain name server and a gateway.

14. The method as claimed in claim 13, wherein the step of transmitting the position information comprises:

a first process of transmitting an address of a domain name server, which has the smallest hop count with respect to the edge router to the edge router; and

a second process of allowing the address of the domain name server transmitted in the first process to be cached in the edge router.

15. The method as claimed in claim 14, wherein the smallest hop count is calculated according to each of the operating modes of the domain name server.

16. The method as claimed in claim 14, wherein the addresses transmitted to the edge router include at least one address for an iterative mode and a recursive mode.

17. A domain name service method, comprising:

transferring a request for position information on one or more domain name servers included in an external link; and

collecting and storing the position information on one or more domain name servers in response to the request.

18. The method as claimed in claim 17, wherein the step of collecting and storing the position information includes allowing a gateway connected between the external link and an Internet network to collect and store the position information.

19. The method as claimed in claim 17, wherein the step of collecting and storing the position information comprises:

a first process, wherein a sub router for connecting the external link to the gateway collects the position information; and

a second process for causing the position information collected in the first process to be stored in the gateway.

20. A domain name service method, comprising:

requesting by a mobile host a domain name service due to changes in a link to which the mobile host is connected; and

transmitting at least one address of at least one domain name server having the smallest hop counts with respect to an edge router connected to the mobile host to the mobile host, in response to the request.

21. The method as claimed in claim 20, the step of requesting a domain name service comprising:

requesting the edge router connected to the mobile host in the changed link to provide the domain name service.

22. The method as claimed in claim 20, the step of transmitting an address of a domain name server comprising:

a first process of transmitting at least one address of at least one domain name server having the smallest hop counts with respect to the edge router to the mobile host in response to the request; and

a second process of causing the transmitted addresses to be cached in the mobile host.

23. The method as claimed in claim 20, the step of requesting a domain name service comprising:

a first process of requesting a domain name server, which is included in a first link to which the mobile host was connected before the link is changed, to provide the domain name service; and

a second process of providing the domain name service through the domain name server in the first process.

24. The method as claimed in claim 23, the step of transmitting an address of a domain name servers comprising:

a first process of requesting the edge router, which is included in the changed link after the link is changed, to provide the domain name service;

a second process of transmitting at least one address of at least one domain name server having the smallest hop counts with respect to the edge router in the first process to the mobile host; and

a third process of causing the transmitted address or addresses to be cached in the mobile host.

25. A domain name service system, comprising:

an address-managing unit, and

an address-collecting unit that communicates with the address-managing unit,

wherein the address-managing unit requests position information on domain name servers included in an external link of a network, and transmits the position information to an edge router connected to a mobile host when the mobile host is moved to the external link, and

wherein the address-collecting unit collects the position information on the domain name servers and provides the position information to the address-managing unit when the mobile host is moved to the external link.

26. A domain name service method, comprising:

collecting position information on one or more domain name servers in a sub domain, and

selecting at least one of the domain name servers to provide domain name service to a mobile host based on the collected position information.

* * * * *